PATENT
1928-0125P

IN THE U.S. PATENT AND TRADEMARK OFFICE

Applicant:	Ben To Fan WONG	Conf.:	5023
Appl. No.:	10/077,974	Group:	
Filed:	February 20, 2002	Examiner:	
For:	MOTOR CASING		

L E T T E R

Assistant Commissioner for Patents
Washington, DC 20231

April 12, 2002

Sir:

Under the provisions of 35 U.S.C. § 119 and 37 C.F.R. § 1.55(a), the applicant(s) hereby claim(s) the right of priority based on the following application(s):

Country	Application No.	Filed
UNITED KINGDOM	0104212.6	February 21, 2001

A certified copy of the above-noted application(s) is(are) attached hereto.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fee required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

BIRCH, STEWART, KOLASCH & BIRCH, LLP

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KM/abs
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Attachment

(Rev. 10/31/01)

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

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Signed [redacted]

Dated 15 FEB 2002

Patents Form 1/77

Patents Act 1977
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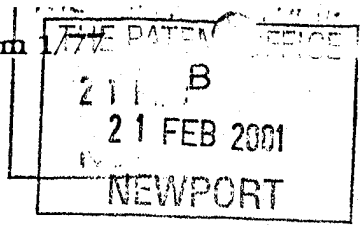

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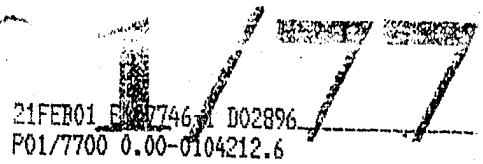

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

21 FEB 2

The Patent Office

Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference — MRH.PO4494GB /P284

2. Patent application number *(The Patent Office will fill in this part)* — **0104212.6**

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

Johnson Electric S.A.
Rue Fritz-Courvoisier 40
CH-2300 La Chaux-de-Fonds
Switzerland

Patents ADP number *(if you know it)* CH01831005

If the applicant is a corporate body, give the country/state of its incorporation — Switzerland

4. Title of the invention

Motor Casing

5. Name of your agent *(if you have one)* — A.R. Davies & Co.

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

27 Imperial Square
Cheltenham GL50 1RQ
England

Patents ADP number *(if you know it)* — 570001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

Yes

Patents Form 1/77

9. **Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document**

Continuation sheets of this form	0
Description	3
Claim(s)	2
Abstract	1
Drawing(s)	2 + 2

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/We request the grant of a patent on the basis of this application.

Signature A.R. Davies Date
A R Davies & Co 20th February 2001

12. Name and daytime telephone number of person to contact in the United Kingdom

Mr M R Higgins
01242 524520

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Notes

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Motor Casing

Field of the Invention

This invention relates to miniature electric motors and in particular, to the housing for a miniature motor.

Description of the Prior Art

Miniature motors vary in size and with small miniature motors, the material of the rear housing part is relatively thin, allowing an end cap or bearing plate to be secured to the rear housing by crimping the rear housing. This crimping process may involve bending over an axially extending finger cut from the edge of the rear housing or simply deforming discrete parts of the edge of the rear housing.

As the size and power of the motor increases, it is also desirable to increase the thickness of the rear housing as it forms the magnetic flux return path for the stator.

However, as the thickness of the rear housing increases so does the power required to crimp the end plates to the metal housing. The metal also exhibits resilience so that when the cut finger crimping method is used with a thick wall housing, say in the order of 2 mm, the finger springs back slightly. While the end cap is still captured by the finger, it is not held firmly against the metal housing resulting in play or movement between the metal housing and the end cap.

Summary of the Invention

Thus there is a need for a method of connecting an end cap to a motor housing which will securely fix the end cap to the housing in a simple yet quick and effective manner.

This need is fulfilled by this invention by using locking tabs which are moved radially to clamp axially the end cap to the housing.

Accordingly, in one aspect thereof, the present invention provides a connection arrangement between a tubular housing and an end cap, wherein the end cap has a boss portion which fits inside the housing and a flange which abuts the end of the housing, and the housing has at least one circumferentially extending finger portion which is radially deformed into a recess in the boss portion of the end cap with an axially inner edge of the finger engaging the end cap to maintain the end cap in contact with the housing.

According to a second aspect thereof, the present invention provides a method of fixing an end cap to a motor housing, comprising the steps of providing an end cap with a flange portion, a boss portion and at least one recess in the boss portion, providing a tubular housing with at least one circumferentially extending finger, inserting the boss portion of the end cap into the housing such that the flange abuts the housing and the recess is aligned with the finger, pressing the finger radially into the recess whereby the axially inner edge of the finger engages the end cap to prevent axial movement of the end cap with respect to the housing.

Preferably, the method also includes providing two pairs of said fingers and radially deforming each pair of fingers into a respective one of the recesses in the boss portion of the end cap, each finger having an axially inner edge which extends at an incline to a plane orthogonal to an axis of the housing, the axially inner edge being brought into contact with an axially inner surface of the recess by radially deforming and continuing to radially deform the finger causing the inner edge of the finger to exert an axial force on the surface of the end cap to clamp the end cap to the housing.

Brief Description of the Drawings

One preferred embodiment of the invention will now be described, by way of example only, in which:

Figure 1 illustrates a tubular housing with an end cap fitted to one end in accordance with the present invention;

Figure 2 is a cross-sectional view of the housing and end cap of Figure 1;

Figure 3 is an end view of the housing and end cap of Figure 1; and

Figure 4 is a cross-sectional view of the end cap of Figure 1.

Detailed Description of the Preferred Embodiment

The housing 10 is a tubular body of electrical steel which may be rolled or deep drawn. The housing has a substantially circular cross-section with two flat sides 12. At each end of each flat side, a T-shaped hole 14 is formed producing a pair of circumferentially extending fingers 16. The fingers 16 have a tapered axially inner edge 18. These fingers 16 are used to secure an end cap 20 to the housing. As shown

in Figure 2, the housing 10 supports permanent magnets 22 forming the stator field for a motor.

While only one end cap is shown in the drawings, the housing illustrated would have an end cap at each end, one supporting a bearing (as shown in Fig. 2) and the other supporting a bearing and brush gear including motor terminals (not shown).

The end cap 20 has a flange 26 which sits on the end of the housing as well as a boss portion 28 which fits inside the housing 10 and extends axially beyond the T-shaped holes 14. Two recesses 30 in the flange 26 and boss 28 are aligned with the pairs of fingers 16 and the fingers 16 are radially deformed into the recesses to secure the end cap to the housing.

Each recess 30 has an axially extending outer lip or ridge 32 which is engaged by the fingers 16. Indeed, the fingers 16 may deform or partly destroy the lip 32 when they are pressed into the recess 30. As the fingers engage the lip, the tapered edge 18 of the fingers 16 apply an axial force pressing the end cap into tight contact with the housing. The more the fingers 16 are pressed radially, the greater the axial force applied to the end cap 20. Thus, even if there is slight springback of the fingers 16 in the radial direction, the axial clamping force will remain resulting in no loosening of the end cap.

The use of the lip 32 allows for slight variation in axial alignment between the fingers 16 and the recesses 30 due to manufacturing tolerances, etc. without affecting the holding force. The lip 32 can be readily sheared radially by the fingers 16 while providing a strong axial abutment, the area behind the lip providing a debris collection zone whereby the sheared lip portion does not interfere with the radial deformation of the fingers.

While only one embodiment has been described, variations will be apparent to those skilled in the art and it is intended to cover all variations which fall within the scope of the invention as defined by the appended claims. In particular, although the fingers are shown formed in pairs, they could be formed individually. Also while two pairs of fingers are shown for holding one end cap, arrangements can be envisaged where there is only one finger or one pair of fingers is required to secure the end cap. Alternatively, three, four or more fingers or pairs of fingers could be used.

Claims

1. A connection arrangement between a tubular housing and an end cap, wherein the end cap has a boss portion which fits inside the housing and a flange which abuts the end of the housing, and

the housing has at least one circumferentially extending finger portion which is radially deformed into a recess in the boss portion of the end cap with an axially inner edge of the finger engaging the end cap to maintain the end cap in contact with the housing.

2. An arrangement according to claim 1, wherein the finger has a tapered axially inner edge.

3. An arrangement according to claim 1 or claim 2, wherein the recess has an axially extending lip and the finger at least partially shears the lip.

4. An arrangement according to any one of the preceding claims, wherein the end cap is a molded resin part.

5. An arrangement according to any one of the preceding claims, wherein there are two recesses in the end cap located at diametrically opposed locations, each recess being aligned with at least one finger of the housing.

6. An arrangement according to claim 5, wherein the housing has two pairs of said fingers and each pair of fingers are radially deformed into a respective one of said recesses.

7. An arrangement according to claim 6, wherein the pairs of fingers are formed by T-shaped holes in the housing.

8. A method of connecting an end cap to a tubular housing, the method comprising the steps of

providing an end cap with a flange portion, a boss portion and at least one recess in the boss portion,

providing a tubular housing with at least one circumferentially extending finger,

inserting the boss portion of the end cap into the housing such that the flange abuts the housing and the recess is aligned with the finger,

pressing the finger radially into the recess whereby the axially inner edge of the finger engages the end cap to prevent axial movement of the end cap with respect to the housing.

9. A method according to claim 8, further including the steps of

providing an axially extending lip on an axially inner portion of the recess, and

shearing a part of the lip by radially bending the finger thereby firmly engaging the end cap to the housing.

10. A method according to claim 8 or claim 9 including the step of providing a tapered surface to the axially inner edge of the finger thus causing a greater axial holding force the more the finger is deformed radially.

11. A method according to claim 8, including the steps of

providing two pairs of said fingers and radially deforming each pair of fingers into a respective one of the recesses in the boss portion of the end cap, each finger having an axially inner edge which extends at an incline to a plane orthogonal to an axis of the housing, the axially inner edge being brought into contact with an axially inner surface of the recess by radially deforming and continuing to radially deform the finger causing the inner edge of the finger to exert an axial force on the surface of the end cap to clamp the end cap to the housing.

Abstract

A connection between a tubular housing 10 and an end cap 20 is made tight by using a circumferentially extending finger 16 on the housing which is bent radially to engage a lip 32 in a recess 30 in the end cap 20 whereby radial deformation of the finger 16 causes an axial clamping of the end cap 20 to the housing 10 without any separation caused by spring back of the finger 16 following deformation.

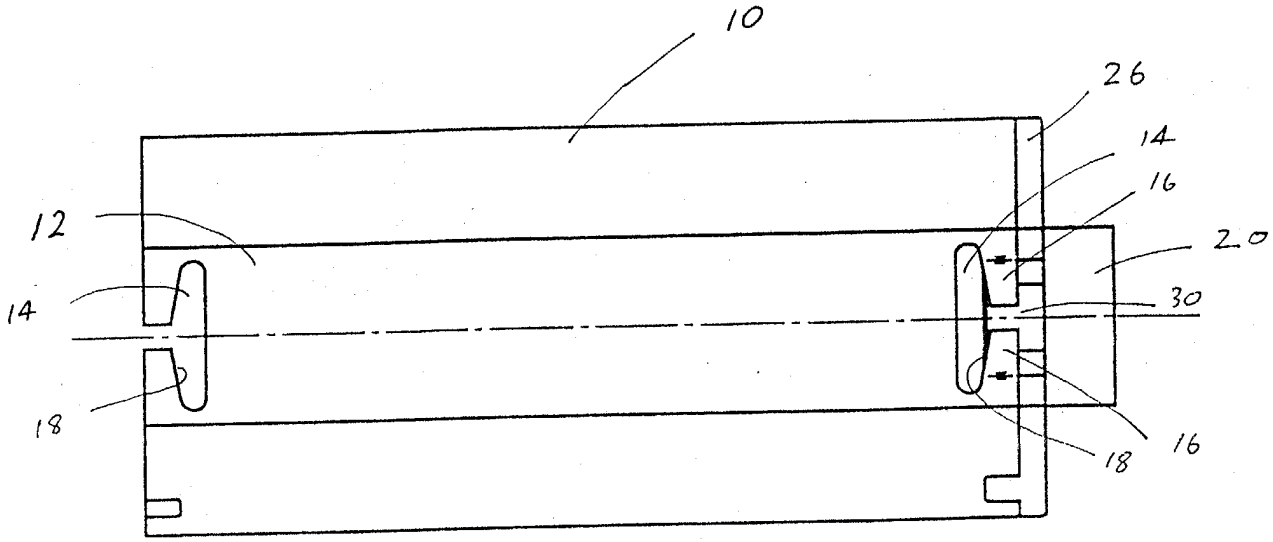
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FIG. 1

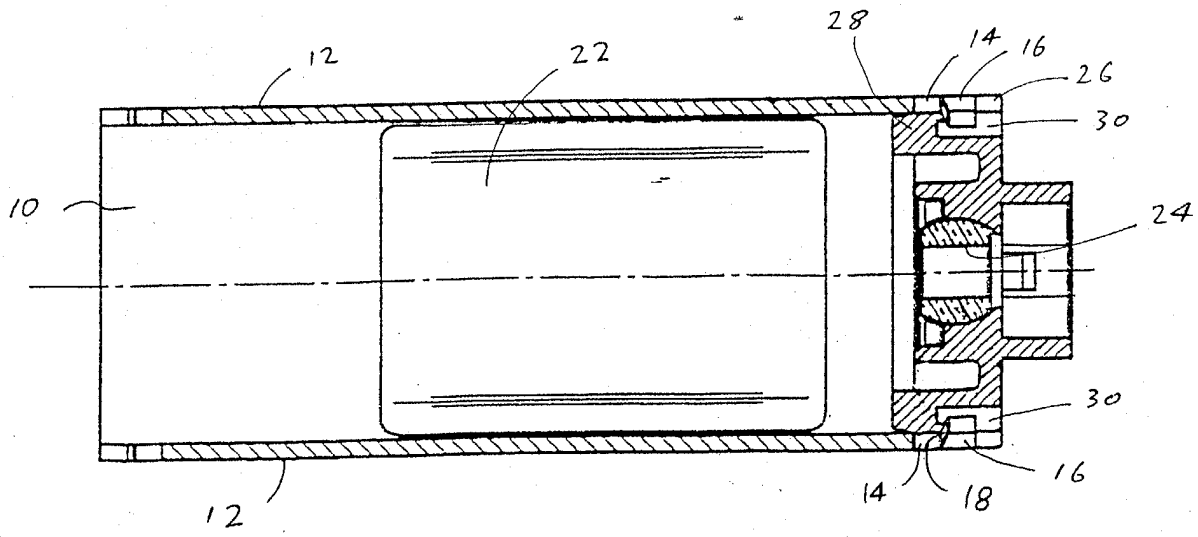
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FIG. 2

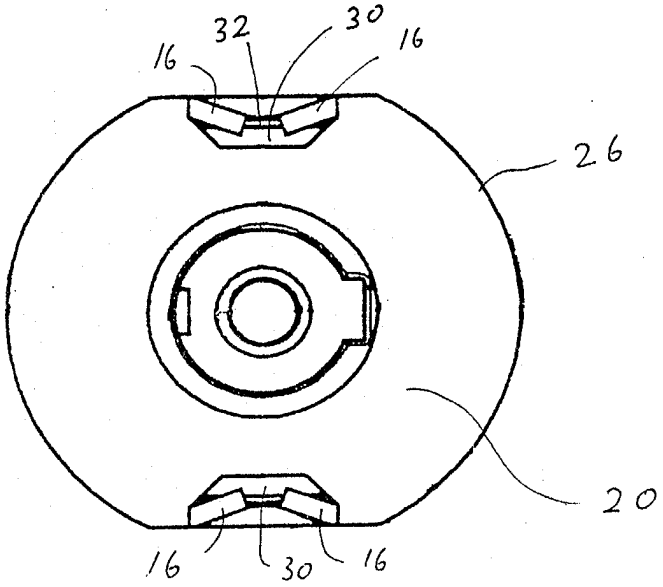

FIG. 3

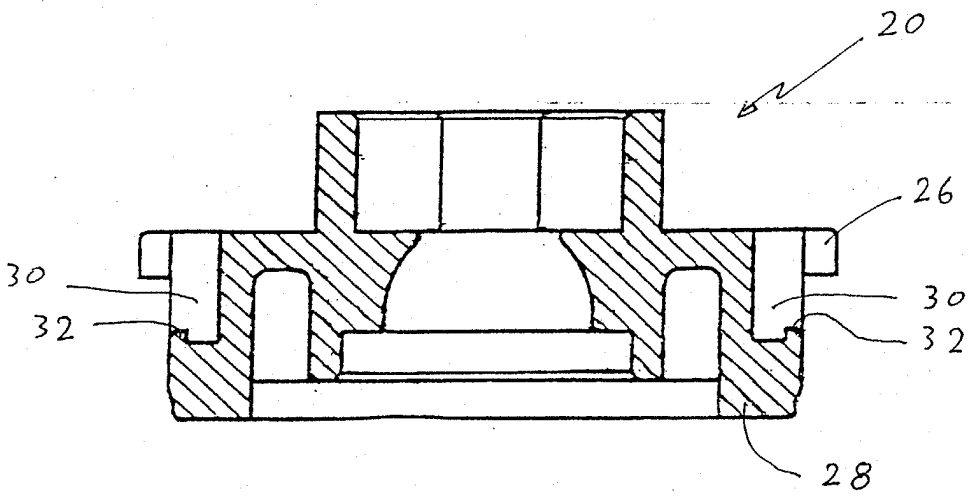

FIG. 4